LOWER CRETACEOUS FOSSILS FROM THE SOURCES OF THE BARCOO, WARD AND NIVE RIVERS SOUTH CENTRAL QUEENSLAND

PART II.[1]—CEPHALOPODA.

By R. ETHERIDGE, JUNR., Curator.

(Plates XXX.-xlix., and Fig. 8.)

I.—INTRODUCTION.

The "Ammonites" proper contained in Mr. H. W. Blomfield's collection are few in number, and will be noticed in a later part of this Memoir. The following descriptions of the "Crioceri" are offered with a considerable amount of diffidence, and to arrive at these results I found it imperative to undertake a general review of our Cretaceous forms hitherto associated with the names *Crioceras* and *Ancyloceras;* the outcome of this work, extending over many months, is to my mind, I regret to say, anything but satisfactory. This arises from two primary causes, the fragmentary state in which the fossils are frequently found, and the difficulty experienced in grouping such portions, from many and widely separated localities, in well defined species. A secondary cause is due to the fact that many of the hitherto described forms are based on portions of shells only, and in two instances at least the descriptions are so inadequate that recognition of the species is practically reduced to guess work. In no instance is this more apparent than in that of *Crioceras australe*, Moore, the Australian type of the group.

To render my investigations as complete as possible, I assembled all the specimens of the above two genera within my reach, and drew upon the following collections, as well as our own:—The Mining and Geological, and Macleay Museums, Sydney; National Museum, Melbourne: Geological Survey, and Queensland Museums, Brisbane; Geological Survey Collection, Adelaide: and the Sweet Collection, Melbourne. For the loan of specimens from

[1] Part i.—See Austr. Mus. Rec vi., 5, 1907, p. 317.

these collections, my thanks are due, respectively, to Mr. E. F. Pittman, Prof. T. W. E. David, Prof. W. Baldwin Spencer, Mr. H. Y. L. Brown, Mr. B. Dunstan, Mr. C. J. Wild, and Mr. G. Sweet, all of whom responded in the most cordial manner to my applications.[2]

With the intention of ascertaining all that could be learnt of the Australian type, *C. australe*, Moore, I enlisted the sympathy and help of my friend, Dr. A. Smith Woodward, who endeavoured to obtain for me a reproduction of Moore's figured specimen, believed to be in the Bath Museum, where the remainder of Moore's collection of Australian Mesozoic fossils is deposited. Most unfortunately, however, this particular fossil appears to be non-extant, either lost or mislaid, and so this avenue of information is closed to me.

This investigation has necessitated an entire reconsideration of all the facts hitherto published regarding our Crioceri and Ancyloceri, and the modification of a good deal of pre-existing work, including my own.

If *Crioceras australe*, Moore, is to remain on our list, then a goodly proportion of the following results is open to suspicion; but if it be permissible to absolutely reject this name, on the ground of insufficient description and loss of type, then I believe the suggested determinations following are as near to the truth as the materials now gathered together will permit of.

II.—As to Crioceras australe, *Moore.*

It is not my intention to recognize *C. australe* as a species, and it is as well, once for all, to give my reasons for so doing. The only characters worthy of note, and they are not of much value, given by Moore are the following:—(1) large size; (2) volutions closely fitting; (3) earlier costæ regular, rounded and slightly curved; (4) later costæ widely separated and acute, with two "depressed bosses on either side" (of the median line of the venter it is presumed?); (5) younger sulci (intercostal valleys) rounded; (6) older sulci regularly concave; (7) mouth seven and a half inches by seven: (8) siphuncle small and immediately ventrad; (9) venter broad, three and a half inches.

Only one of these characters is of sufficient importance to be specific, the occurrence of the two "depressed bosses" on either

[2] The present paper will therefore contain descriptions of fossils from localities other than those comprised within the geographical boundaries given in the title.

side; the others are common to all our larger *Crioceri* at some period of their growth. Moore could have told us whether or or no these large tubercles occur on each costa, or on alternate costæ, or the tubercle-bearing costæ separated by many or few undecorated ribs, all important points in the separation of our species, as will be seen later. Again, nothing definite is said of the relative positions of these tubercles, whether abdominal, lateral, or supra-dorsal.

I certainly laboured under the impression I knew *C. australe*, and have so named specimens; now, however, I can only regard such determinations as hasty generalisations. If Moore's species is to be retained and distinguished by possessing two rows of tubercles on each side the middle line of the venter in the gerontic condition, then we are left with many non-tuberculate specimens in a younger stage of growth that must remain, from their imperfect condition, nameless. During my researches in Australian Cretaceous Palæontology, I have never met with a large *Crioceras* possessing two such rows of tubercles in the aged condition of the coil.

Moore said of his species—"shell very large." We certainly do possess a huge so-called *Crioceras*, or perhaps even two, in our Cretaceous beds. Mr. Felix Ratte figured[3] about one-half of a shell ascribed to *C. australe*, the perfect diameter of which would have been about four feet, and so far as the state of preservation discloses, non-tuberculate.

The late Dr. W. Waagen ascribed to this species a large Indian Cretaceous shell[4] without any trace of the two rows of tubercles on the more adult whorls, but, on the other hand, with fasciculate costæ and two rows of large tubercles on the younger, or inner whorls; this was a direct departure from Moore's description. I committed a further mistake by including[5] a shell of fine growth in *C. australe*, apparently entirely devoid of tubercular ornamentation.

Under these circumstances, viz., the incompleteness of Moore's description; the loss of his type-specimen; and the different interpretation put on the meaning of the name by Messrs. Ratte, Waagen, myself, and collectors in general, I am induced to abandon the name as the most direct way out of a serious difficulty.

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[3] Ratte—Proc. Linn. Soc. N. S. Wales, (2), i. 1886, pl. ii.

[4] Waagen—Jurassic Fauna of Kutch (Pal. Ind.), Ceph., 1875, i., No. 4, p. 246, pl. lx., figs. 1 *a-c*.

[5] Etheridge—Geol. Pal. Q'land, etc., 1892, pl. xxxi., f. 1.

III.—The Names Crioceras and Ancyloceras.

Before proceeding with the specific descriptions, it may be well to pass in review some facts in the history of these genera. Leveillé's original description as *Crioceratites* is not available, and I have to fall back on D'Orbigny's,[6] which is a very wide definition. The principal features of his *Crioceras*, irrespective of the sutures, were a discoidal form, the coil enrolled in one plane, the whorls non-contiguous, and an oval, round, or compressed mouth. From the figures, the first of which is Leveillé's type (*C. duvalii*), we learn these interesting facts, viz., the increase in the circumference of the whorls was comparatively slow and slight, the coil a very open one, and in the type three rows of tubercles on each side the middle line of the venter. D'Orbigny's *Ancyloceras* so closely resembles *Crioceras* in its earlier stages that Mr. J. E. Astier[7] united the two, in which he was followed by Messrs. Pictet and Campiche, but unfortunately they selected the former name, thereby denying to Leveillé's genus its undoubted priority. Palæontologists have since used both names, some one and some the other. The whole question is excellently and clearly put in favour of *Crioceras* by Messrs. Sarasin and Schondelmayer, to whose remarks[8] the reader is referred, but they point out that the genus *Crioceras* is, amongst all the genera of Ammonitidæ, one of those interpreted very differently by authors. Amongst those who are in accord with the above authors are Messrs. M. Neumayr, M. Neumayr and V. Uhlig, and E. Haug.

The difficulty appears to have been to find some satisfactory method of division into genera of the heterogeneous assemblage of forms previously known as *Crioceras*, to replace the old D'Orbignyan one of degree of enrolment. The artificial nature of this method was, I believe, first pointed out by Dr. M. Neumayr, who suggested a division of the Ammonitidæ on the basis of natural kinship, to some extent then already foreshadowed by Quenstedt and Pictet.

Neumayr and Uhlig described[9] three lines of development of *Crioceras* forms from Ammonite stocks—one from *Olcostephanus*, viz, *C. fissicostatum*; a second from *Hoplites* (*H. hystrix*), viz., *C. roemeri*, N. & U.; and the third also from *Hoplites* (*H. longinodis*), viz., *C. seeleyi*, N. & U. These authors did not

[6] D'Orbigny—Pal. Franç Terr. Crét., i., Ceph., p. 475.
[7] Astier—Ann. Sci. Phys. Nat. Soc. Nat. Agric Lyon, (2), iii., 1851, p. 435
[8] Sarasin and Schondelmayer—Mém. Soc. Pal. Suisse, xxix., 1902, p. 99.
[9] Neumayr and Uhlig—Palaeontographica, xxvii., 3-6, 1881, p. 184.

define *Crioceras*, but from developmental facts brought forward discussed the propriety of subdividing the genus. Glancing through their figures I find their conception of the latter includes —(*a*) close coiled forms (*C. seeleyi*); (*b*) the same with a shaft or limb (*C. urbani*); and (*c*) open coiled forms (*C. capricornu*, *C. roemeri*).

In 1883(?) Dr. V. Uhlig restricted *Crioceras*[10] by removing from it *C. asterianum*, D'Orb., and with *Hamites depressus* establishing for them the genus *Pictetia*,[11] as a connecting link with the Ammonite *Lytoceras*, Suess. Uhlig further removed from *Crioceras* a group of species typified by *C. puzosianum*, D'Orb., of a more or less dwarfed habit, and a loose open coil, as *Lytoceras*.[12] The embryonal chamber in the last named is followed by one, or one and a half, smooth whorls, when costæ are gradually acquired, with a limb and crozier. Uhlig, after a close study of the Cephalopoda of the Wernsdorf beds, arrived at the conclusion that the major part of the forms referred to as *Crioceras* or *Ancyloceras* were genetically annexed to *Hoplites*, and that a generic distinction between the spiral *Crioceri* and those of the *Ancyloceras* type was superfluous.

In 1889 Mr. E Haug suggested a separation of *Crioceras* and *Ancyloceras* based on the sculpture which he considered was much stronger on the "dwelling chamber" (shaft and crozier) of *Ancyloceras* than on the spirally inrolled whorls "which in *Crioceras* never appear to be the case"[13]; he selected *Ancyloceras matheronianum*, D'Orb., as the type of *Ancyloceras*, and included in it both close and open-coiled shells[14]; as an example of the former is *Scaphites coquandi*, Math., and of the latter *S. provinciale*, Math. The sculpture selected by Haug as typical of his definition of *Ancyloceras* consists of a uniform double row of tubercles on the flanks and two rows of abdominal tubercles (*i.e.*, one on each side the median line of the venter) always on the crozier, and sometimes on the spiral.[15] So far as I can understand his meaning, Haug appears to regard all *Crioceri* as constantly inrolled in a plane, bow-shaped, or spiral, in the latter case with or without a crozier.

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[10]Uhlig—Denks. K. Akad. Wiss. Wien., xlvi., 2, p. 258.

[11]Uhlig—*Loc. cit.*, p. 202. The name *Pictetia* was subsequently (1885) proposed by C. Brongniart for a Neuropterous insect.

[12]Uhlig—*Loc. cit.*, p. 260.

[13]Haug—Beiträge Pal. Öster.-Ung. Orients, vii., 3 and 4, 1889, pp. 207 and 212.

[14]Haug—*Loc. cit.*, p. 214.

[15]Haug—*Loc. cit.*, p. 214.

Haug's restriction of *Ancyloceras* was regarded by Dr. D. J. Anthula[16] as unsatisfactory; although he stated his opinion that a trustworthy definition of the D'Orbignyan genus could not be given.

In 1902 appeared the paper, already quoted, by Messrs. Sarasin and Schondelmayer.[17] These authors vigorously dispute Dr. Haug's definition of *Ancyloceras* on the grounds that it is contrary to the generally admitted opinion in phylogenetic classification to give importance to the characters of the terminal portion of the shell in preference to the initial. They define *Crioceras* as consisting of species "derived from Hoplites, which present disjointed whorls with an inrolment sometimes crioceratic, sometimes ancyloceratic." The mode of enrolment employed by D'Orbigny is not of preponderating importance, nor is a group classification of the species assisted by the structure of the sutures, in consequence of their uniform and constant characters; on the other hand, the sculpture of the initial whorls is a good feature for differentiation into groups.

These authors divide *Crioceras* (+*Ancyloceras*) into seven groups, each corresponding to a subgenus. For their second group (or subgenus) they reserve the name *Ancyloceras*, with *C. renauxianum*, D'Orb., as type, instead of *A. matheronianum*, D'Orb., the more usually accepted type. Messrs. Sarasin and Schondelmayer, whose paper is dated 1902, do not appear to have had the advantage of consulting Hyatt's classification published in 1900. Their second group, just referred to, contains two of Hyatt's genera—*Tomoceras* (*A. duvalianum*, D'Orb.), and *Dirrimoceras* (*A. simplex*, D'Orb.). The third group, typified by *Ancyloceras matheronianum*, D'Orb., is, according to Hyatt, *Ancyloceras* (*sensu strictu*)! Lastly, the fourth group, with *A. tabarelli*, Astier, as its representative, is more or less equivalent to Hyatt's *Acrioceras*, of which the species named is the type.

In 1900 appeared the first volume of Eastman's translation[18] of Zittell's 'Grundzüge der Palæontologie,'[19] with the article 'Cephalopoda' revised and in a great measure rewritten by the late Prof. A. Hyatt, and containing the classification referred to above; it is to be regretted that this highly

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[16]Anthula—Beiträge Pal. Öster.-Ung. Orients, xii., 3, 1899, p. 124.

[17]Sarasin & Schondelmayer—Mém. Soc. Pal Suisse, xxix., 1902, p. 99.

[18]Eastman—Text-Book of Palæontology. By Karl A. von Zittel, i., 1900. 8vo. London.

[19]Zittel—Grundzüge der Palæontologie (Palæozoologie) 8vo. Munich and Leipzig, 1895.

talented man did not live to elaborate the classification there forecast. Hyatt distributed the evolute Cephalopods through several families, but those with which we are at present chiefly concerned are the following :—

1. *Ancyloceratidæ*—"Includes only such forms usually assigned to *Ancyloceras*, *Crioceras*, etc., as have three rows of tubercles on either side on the larger costæ. Between the latter are smaller costations without tubercles. Costæ sometimes interrupted across the venter by a smooth zone." Figures *A. matheronianum*, D'Orb.

2. *Crioceratidæ*—" . . . with only two lines of tubercles on either side of the median line of the venter. The latter may have a smooth zone or be crossed by the costæ, which are either single or double between the tubercles "

3. *Anisoceratidæ*—" . . . . two rows of tubercles on either side the median line of the venter. Costæ large and single, or imperfectly bifurcate, and may cross the venter."

4. *Hamitidæ*—Single costæ crossing the venter uninterruptedly, and no tubercles at any stage.

It appears to me that Hyatt attached considerable classificatory value to the external sculpture, and had he lived to complete his work a path very difficult to others would have been rendered smoother.

IV.—Australian Crioceri.

There is a strong community of structure throughout all the Australian shells of this type. It is only by attention to the degree of inrolment, breadth of the venter, convexity of the flanks and the sculpture, that specific separation and demarcation can be attained; I have paid attention, as a primary means, to the sculpture of the initial whorls, in the few instances in which it is visible. Nearly all our forms appertain to the more closely coiled type; apparently only two show any tendency to the open coil condition. I do not give detailed descriptions of the sutures. The specific differences appear to be so trivial that short of a special terminology for the lobe and saddle subdivisions it is impossible to express oneself clearly and at the same time tersely. Suffice it to say that throughout the species the community of structure in this respect is remarkable. In this they appear to be in accord with those forms studied by Messrs. Sarasin and Schondelmayer. The septa, speaking generally, throughout our specimens, are divided into six principal lobes as in the typical Hoplite-like *Crioceri*, such as *C. emerici*, *C. matheronianum*, etc.; the superior lateral lobes are always the longest with a broad body.

The descriptions that follow cannot be regarded as eminently satisfactory, nor do I see how such can be the case when the

sculpture varies at different stages of growth, and I am mainly dependant, although not in every instance, on incomplete material.

If the tuberculation be made use of as a guide, to some extent following Hyatt's lead, we find the Australian species can be arranged as follows :—

1. Without tubercles of any kind. *C. taylori*, mihi.
2. Tubercles only in the youngest condition, one row on each side the middle line of the venter. *C. nautiloides*, mihi.
3. The same as No. 2, with three rows of tubercles. *C. jackii*, mihi.
4. With one row of tubercles on each side the middle line of the venter throughout life (*i.e.*, as far as known)—*C. axonoides*, mihi ; *C. flindersi*, McCoy; and *C. plectoides*, mihi.
5. With two rows in a similar position throughout life. *C. laqueus*, mihi ; *C. cordycepoides*, mihi.
6. With three rows in aged individuals (young stage unknown). *C. lampros*, mihi.

According to Hyatt's classification, only one of these groups (No. 5) can be strictly regarded as a member of the Crioceratidæ, and one referable to his Ancyloceratidæ (No. 6).

The diminutive forms of the Point Charles and Shoal Bay beds are too fragmentary, in most cases, for an opinion to be formed of their more perfect condition. Not long since I endeavoured[20] to provisionally refer these to genera, but without marked success.

It is almost superfluous to mention that our Australian species, with one possible exception, are not typical *Crioceri* of the *C. duvali* group. The latter throughout their volutions are more or less pipe-like, and increase but little in diameter. On the contrary, the former do, and are much more ammonoid, and even to some extent nautiloid, in appearance. In this respect if one conceives *Pictetia asterianum*, D'Orb.,[21] to be closer coiled than it is, the resemblance to our *C. jackii* in the gerontic stage is very marked. This ammonoid-like appearance was remarked on by Neumayer and Uhlig in *C. fissicostatum*, Roemer.[22]

In some dwarfed European species Uhlig discovered[23] that the first, or first and a half, volutions succeeding the embryonal are

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[20] Etheridge—S. Austr. Parl. Papers, 1907 (Suppl. to No. 55, 1906), pp. 15-18, pls. ix.-xi.

[21] D'Orbigny—Pal. Franç. Terr. Crét., Ceph. i., 33-42, 1842, pl. cxv. *bis*, figs. 3 and 4.

[22] Neumayr & Uhlig—Palaeontographica, xxvii., 3, 1881, p. 182, pl. lvi., f. 1.

[23] Uhlig—Denk. K. Akad. Wiss. Wien, xlvi., 2, p. 260.

smooth, the following whorls gradually acquiring costæ as growth went on. These he separated as *Leptoceras*, and one of our smallest species appears to me to fulfil these conditions, viz., *C. edkinsi*, mihi.[24]

As Hyatt did not live to elaborate his classification, it is my intention, in the following pages, to refer the whole of the Australian forms to *Crioceras*, with the exception of the species just mentioned. When the limits of *Crioceras* have been defined by those with large collections at their disposal and access to the old types, it will be possible to relegate our local species to their respective groups.

Genus Crioceras (*Leveillé*), *D'Orbigny*, 1842.[25]

Crioceratites, Levillé, Mém. Soc. Géol. France, ii. 1836, p. 313 (*fide* D'Orb.).
Crioceras, D'Orbigny, Pal. Franç. Terr. Crét. i. (Ceph.), 33-42 1842,[26] p. 457.
Ancyloceras, D'Orbigny, *ibid.*, p. 491.
Ancyloceras, Astier, Ann. Sci. Phys. Nat. Soc. Nat. Agric. Lyon, (2), iii., p. 435.
Crioceras, Neumayer and Uhlig, Palæontographica, xxvii., 3, 1881, p. 181.
Crioceras, Uhlig, Denk. K. Akad. Wiss. Wien, xlvi., 2, 1883, p. 258.
Crioceras, Haug, Beiträge Pal. Ost.-Ung. Orient, vii., 3 and 4, 1888, p. 206.
Ancyloceras, Haug, *ibid.*, pp. 211 and 214.
Crioceras, Anthula, *ibid.*, xii., 3, 1899, p. 124.

Crioceras(?) leptus,[27] *sp. nov.*

(Plate xxx.; Plate xxxiv., fig. 2.)

Sp. Chars.—Size of shell unknown. Venter rounded, narrow; abdominal margins rounded; dorsum flat, costate; impressed

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[24]Etheridge—Geol. Pal. Q'land, etc., 1892, p. 502, pl. xxx., figs. 8 and 9.
[25]As an addition to Mr. C. D. Sherborn's remarks (Geol. Mag., (4), vi., 1899, p. 223) on the dates of publication of the "Livrasons" of D'Orbigny's Cephalopoda (Pal. Franç.) I would point out that Bronn (Index Pal., i., 1848, p. 348) gives 1840 as D'Orbigny's date of *Crioceras*. It may also be mentioned parenthetically that the latter in one publication (Pal. Franç. *loc. cit.*, p. 459) gives Leveillé's date as 1836, and in another (Prod. Pal., ii., 1850, p. 65) as 1837, whilst Bronn (*loc. cit.*) as 1835.
[26]Date *fide* Sherborn.

zone absent; flanks so very little rounded as to appear almost flat; section longitudinally and obtusely triangular (or longitudinally deltoid). Costæ single, obtuse, broadening forwards, straight on the venter, curved slightly forwards on the dorsum, and simply oblique, or very slightly sigmoidal on the flanks; intercostal valleys delicately lined to correspond with the costæ.

Obs.—Three disunited portions of whorls are referred to under this name, two of which may belong to the same individual specimen. Three characters combined serve to distinguish these, viz., the narrow venter, comparatively flat flanks, and the absence of tubercles. In the second of these features there is a general agreement with *C. axonoides*, but the tubercles of the latter are wanting. The three specimens are to some extent exfoliated, but I hardly think this would have obliterated all trace of tubercles, had the latter ever existed. The costæ agree with those of the median and older conditions of *C jackii*. The flat, or almost straight-walled flanks assist materially in giving rise to the longitudinally deltoid outline of the transverse section of the walls, which is entirely unlike that of *C. jackii*. Pending the acquisition of more perfect material, the claim of these disunited portions to specific rank can only be regarded as tentative.

Loc.—Lind River, a branch of the Mitchell River, Cape York Peninsula [G.S.Q.; and A.M. (*W. Cope*)].[27a]

Crioceras, *sp.*

(Plate xxxviii., figs. 1, 2.)

Obs.—This fragment is figured for future reference. It consists of portion of one whorl only, long-oval in transverse section, with a narrow rounded venter, a flat dorsum, exhibiting hardly any trace of an impressed zone, and absolutely flat flanks. The costæ are obtuse (although not large), particularly on the venter, which they cross without curvature, but on the dorsum are faintly inflected forwards, whilst on the flanks these ribs are slightly

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[27] λεπτός, thin.

[27a] The abbreviations used in this and following localities are as follows:—
A.M. = Australian Museum Collection, Sydney.
Q.M. = Queensland Museum Collection, Brisbane.
G.S.Q. = Geological Survey of Queensland Collection, Brisbane.
G.S. = G. Sweet Collection, Melbourne.
U.S. = Macleay Museum, University of Sydney.
M.G.M. = Mining and Geological Museum, Sydney.
N.M.M. = National Museum, Melbourne.
G.S.S.A. = Geological Survey S. Australia Collection, Adelaide.

sigmoidal ; here and there one is bifurcate, the bifurcations supra-dorsal in position. There is one row of pimple-like, uniform tubercles, on either side the median line of the venter, along the abdominal margins, one on each costa.

The specimen agrees with *C. leptus* except in the bifurcation of a few of the costæ, and the presence of the pimple-like tubercles.

Amongst the Port Darwin Cretaceous fossils of Shoal Bay occurred a small *Crioceras*[28] whorl which may possibly be an inner volution of this form, although the venter is subtruncate instead of round, and a well-marked impressed zone is present. Attention is mainly called to this with the view of future identification.

Loc.—Barcoo, Ward, and Nive Rivers District [A.M. (*H. W. Blomfield*).]

Crioceras jackii, *Eth. fil.*

(Plate xxxi.; Pl. xxxii., figs. 1, 2 and 3; Pl. xxxiii., fig. 1; Pl. xxxiv., fig. 1; Pl. xxxv., fig. 1; Pl. xxxvi., fig. 1; Pl. xxxvii.; Pl. xxxviii., figs. 3-5.)

Crioceras jackii, Eth. fil., Proc. R. Phys. Soc. Edinb., v., 1880, p. 305, pl. xvii., figs. 55-58.

Crioceras irregulare, Ten. Woods, Proc. Linn. Soc. N. S. Wales, xvi., 1882, p. 151, pl. viii., f. 2.

Crioceras australe, Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 499, pl. xxxi., f. 1; pl. xxxii., figs. 1-5.

Crioceras irregulare, Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 501, pl. xxxiii., f. 1; pl. xlii., f. 16.

Sp. Chars.—Shell large, robust, whorls five or six, close coiled, rapidly enlarging and overhanging one another; venter rounded or convex, rapidly broadening as the shell grew; siphuncle small; abdominal margins obtuse; dorsum more or less concave, costate; impressed zone broad, shallow ; flanks convex ; umbilical cavity wide and open ; section varies from octagonal round the fully tubercled costæ to transversely deltoid around the non-tubercled. Sculpture varies at different stages of growth ; the first two and a half to three whorls bear a series of prominent or thickened obtuse costæ separated by from two to four (commonly two) ordinary round small costæ, all close together; beyond the above point costæ are all simple, regular and uniform, or a few bifurcate

[28] Etheridge—S. Austr. Parl. Papers (Suppl. to No. 55, 1906), 1907, p. 17, pl. ix., figs. 7 and 8.

merely, gradually enlarging or broadening, and becoming separated by wider and wider intercostal spaces, on the venter somewhat convex forwards, on the dorsum more so, and on the flanks distinctly sigmoidal ; intercostal spaces (or valleys) finely lined. Tubercles very characteristic and confined to the earliest whorls, comprised in from one to three rows on each side the middle line of the venter as prominent, bold nodes; when only one row, this occurs along each abdominal margin ; when two, the second appears at about the middle line of each flank ; and when three, the third is supra-dorsal in position ; when in three series, these nodes gradually die out in the following order—the supra-dorsal disappear first, the flank nodes next, and finally the abdominal nodes on some part of the third whorl. Septa with very undulating surfaces from the high development of the lobes and saddles.

Obs.—It will be remembered that subsequent to my original description of *C. jackii*, I referred[29] the latter to *C. australe*, Moore, as the younger stage of the latter. This determination I can no longer uphold, through my inability to recognise *C. australe.* I was led to this chiefly by Dr. W. Waagen's conception of *C. australe*, and still believe that the last named and my *C. jackii* are one and the same. The acquisition of additional material has increased my knowledge of both the older and younger conditions of *C. jackii*, and it now appears to be one of our best defined species.

In a former synonomy I united with *C. jackii* under the common name *C. australe*, the late Mr. F. Ratte's figures[30] of the large *Crioceras* in the Australian Museum. This monster, when perfect, must have possessed a diameter of upwards of four feet, but its state of preservation is so unsatisfactory that I now feel diffident of passing an opinion on its identity; tubercles are not visible. The largest specimen I feel disposed to refer to this species measures eleven inches by nine inches cross-diameters, the breadth of the last existing whorl being five inches from the middle of the venter to the umbilical edge.

The general appearance is decidedly ammonoid, particularly that of the *Lytoceras* group, arising to some extent from the close contiguity of the whorls to one another, although in this feature there is slight variability. In some cases the coil is close, in others there is an appreciable void between the volutions, when the projecting conical tubercles along the ventro-lateral margins become conspicuous.

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[29] Etheridge—Geol. Pal. Q'land, etc., 1892, p. 499.
[30] Ratte—Proc. Linn. Soc. N. S. Wales, (2), i., 1886, p. 133, pls. i. and ii.

The costæ of the specimen mentioned in the latter portion of the last paragraph but one, are one inch apart, and as the shell increases in age the sigmoidal curvature becomes less apparent, and the costæ straighter or less curved. On these mature whorls these large costæ are more abruptly inclined on their fore aspects, gradually sloping or shelving off on their hinder faces into the concave valleys or intercostal spaces; this is a characteristic feature of *C. jackii*.

The costæ of the tuberculate whorls, and for some distance beyond the termination of the nodes, are uniformly convex, obtuse and close. Those bearing tubercles are always more or less swollen and enlarged, with from two to four simple ribs between them. The normal number of rows of tubercles is certainly three, as already described, but specimens are before me with two, or even only one row visible. At the same time it may be accepted as a fact that in no instance has a specimen with the general characters ascribed to this species been found to possess nodes beyond about the third or certainly the fourth whorl.

The section of the tubercle whorls is octagonal, the venter between the two abdominal rows being truncate and hollowed. The section of the remainder of the whorls is transversely deltoid.

The convexity of the flanks and the marked difference in sectional outline at once distinguishes *C. jackii* from the portions I have termed *C. leptus*.

To some extent in its young state it is our representative of the magnificent European *C. romeri*, N. & U.,[31] but the latter is much more highly ornate and the costæ of the two forms differ otherwise. In general appearance *C. jackii* is not unlike the American form *C. percostatum*, Gabb[32]; a comparison may also be made with *C. ramososeptatum*, Anthula,[33] in which the first three whorls are also nodose.

In a previous paragraph it is stated only one row of tubercles *may* occur on the earliest volutions of this species. Indeed, one may go a step further by calling attention to specimens in which no trace of tubercles is visible, but otherwise presenting the costal features of the more mature conditions of *C. jackii*. These costæ are remarkably regular, thick, rounded, although rather depressed, particularly on the venter, where they are

[31] Neumayr and Uhlig—Palaeontographica, (3), xxiii., 1881,3,p. 187,pl. lv.

[32] Gabb—Pal. California, i., 4, 1861, pl. xvi.

[33] Anthula—Beiträge Pal. Öster.-Ung. Orients, xii., 1900, pl. xiv., f. 4*a*.

slightly inflected forwards, broadening as the shell grew ; on the flanks some of the costæ are directly transverse, others faintly sigmoidal.

I have repeatedly hesitated to unite these shells (typified by Pl. xxxi.) with *C. jackii* proper (typified by Pl xxxii., fig.1; Pl. xxxiii., fig.1; Pl. xxxv., fig.1), but their respective forms, mode of inrolment and costal characters are so similar, I ultimately felt unjustified in separating them in the present state of my knowledge. It may ultimately be necessary to do so, if it can be shown by dismembering the whorls, or obtaining portions in such a condition, that even one row of the characteristic *C. jackii* tubercles is not present, although some specimens undoubtedly possess the swollen costæ of *C. jackii.*

Locs.—Walsh River, a tributary of the Mitchell River, Cape York Peninsula [G.S.Q.; Q.M.]. Saltern Creek, north of Barcaldine, Central Queensland [Q.M.] Roma, South-east Queensland [Q.M.]. Hughenden, North-Central Queensland [Q.M.; G.S.]. Tate River, a branch of the Lynd River, Cape York Peninsula [G.S.Q.]. Barcoo, Ward and Nives Rivers District, South-Central Queensland [A.M. (*H. W. Blomfield*)]. West-south-west of Mount Mulligan, near Walsh Telegraph Station, Cape York Peninsula [G.S.Q.].

Crioceras nautiloides, *sp. nov.*

(Plate xlv., and Fig. 8.)

Sp. Chars.—Shell of medium size, robust. Whorls, only two known, close coiled, very rapidly enlarging and greatly overhanging one another; initial whorl unknown; venter very broad and convex; abdominal margins very obtuse; dorsum broad, flattened, impressed, costate ; impressed zone broad ; flanks very convex ; umbilical cavity wide and deep ; section transversely-broad-oval. Sculpture varies at different stages of growth ; in the first whorl known the costæ are both simple and fasciculate, from one to three of the former separating two or three of the latter ; on the succeeding large whorl all are simple, straight on the venter, gently bent forwards on the dorsum, and faintly sigmoidal on the flanks ; tubercles are confined to the first whorl preserved, one row on each side the middle line of the venter, latero-ventral in position, uniting the costæ in fasciculi of two or three.

Obs.—The specimen yielding the above characters is imperfect, lacking the inner whorls except one, and also deficient at the distal end. Although only a cast and possibly at one time semi-

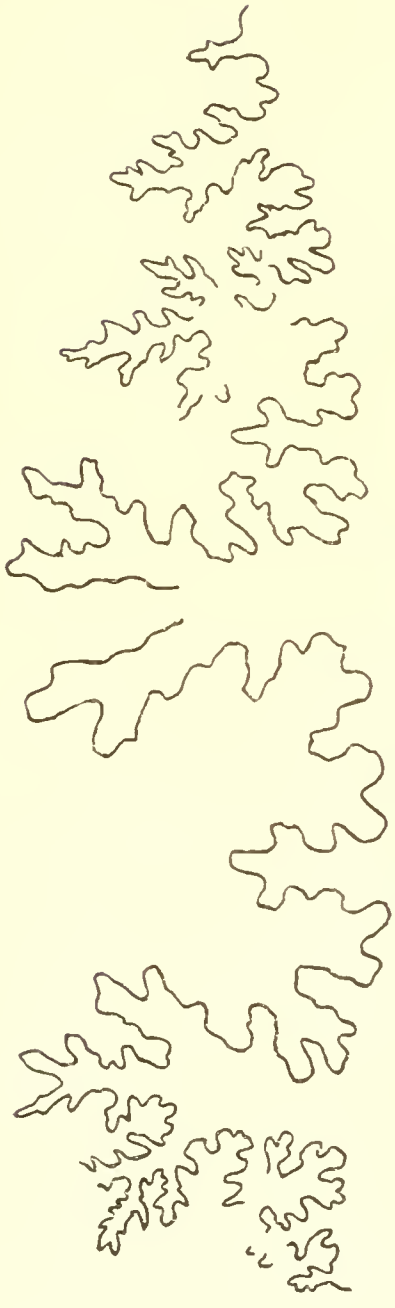

Fig. 8. Incomplete suture of *Crioceras nautiloides*, Eth. fil.

plastic, I do not think it has undergone distortion. If the latter be the case, it is remarkable for the breadth of the rounded venter, and convexity of the flanks. The section, a transverse broad oval, is more truly oval than any other of our forms, even than that of *C. plectoides*.

In possessing tubercle-united fasciculi of costæ *C. nautiloides* resembles *C. axonoides*, but whilst the tubercles of the latter continue throughout life (so far as the shell is known), in the present species they stop short at a certain period of growth, as in *C. jackii*, and do not appear on the more mature whorls. Were it not for the fasciculate condition of the costæ, no objection could be raised to including this with *C. jackii* provisionally on the ground of distortion arising from plasticity as a cast.

Loc.—Aramac, Thomson River, Central Queensland [G.S.Q.]

Crioceras axonoides,[34] *sp. nov.*

(Plate xxxii., fig. 4; Pl. xliv., fig. 1.)

Sp. Chars.—Shell large, with a depressed discoidal appearance. Whorls four (as far as known), close coiled, very gradually enlarging and not greatly overhanging one another; initial whorl unknown; venter comparatively narrow; abdominal margins rounded and tuberculated throughout life; dorsum flat, costate; impressed zone imperceptible; flanks very gently rounded, inclined to be straight-walled; umbilical cavity wide, comparatively shallow, and open; section longitudinally and obtusely triangular (deltoid). Sculpture varies at different stages of growth; on the earlier whorls the costæ are oblique and both simple and in fasciculi, the former one or two in succession, the latter in groups of two or three; on the later whorls all are simple and non-fasciculate; on the venter of the inner whorls straight, and simple or fasciculate; on the flanks of the outer whorls oblique, and on the venter straight; on the dorsum throughout bent forwards. Tubercles in one row on each side the middle line of the venter along the abdominal margins; on the inner whorls prominent, pointed, and conical, uniting the fasciculate costæ in bundles of two or three, usually the latter, gradually lessening in size as the shell grew, and on the fasciculi ceasing, one blunt tubercle to each costa.

Obs.—This species must have attained a large size; the figured example possesses a diameter of ten and a half inches. One of

[34] *αξων, ονος*, a wheel.

the most important features is the retention of the tubercles throughout life, or at any rate so far as the latter is known, and their occurrence on each costa after the cessation of the fasciculate grouping of the costæ. At what precise stage this took place it is difficult to say, as the inner whorls are incomplete. In the figured example, however, the shell had attained to a diameter of four inches before the change from fasciculation to simplicity took place. This change in the sculpture is a very important feature, because in a species to follow *C. flindersi* the grouping of the costæ continued on to the shaft and crozier, *i.e.*, throughout life. The fasciculi usually consist of three costæ, but sometimes two, gathered into a bundle by the conate tubercles, then crossing the venter separately; these fasciculi are separated by from one to two simple ribs. In this grouping of the costæ there is a good deal of character, difficult to express in words, for although the early costation of *C. nautiloides* is fasciculate, the general appearance from that of the present form is quite different.

Loc.—Queensland! [U.S.].

Crioceras ammonoides, *sp. nov.*

(Plate xlix., figs. 1, 2.)

Sp. Chars.—Shell small, ammonoid, compressed. Whorls two and a half known; earliest whorls open and loosely coiled; later whorls close and contiguous; initial whorl vermiform, with an acute apex (?); venter narrow, depressed-convex; abdominal margins rather sharp, inclined to be angular; dorsum and impressed zone unknown; dorsal or umbilical margin rather sharp and somewhat angular; flanks broad and almost flat; umbilical cavity wide and open; section deltoid-ellipsoidal. Sculpture on the initial whorl of transverse micro-striæ, on the remainder of the whorls either of single or bifurcate costæ, or in fasciculi of two; on the venter straight, on the flanks sigmoidal; tubercles small and papilla-like, in a single row along each abdominal margin, and at varying distances apart, both on single costæ, or uniting the fasciculi, separated by from one to four non-tuberculated costæ.

Obs.—I have three specimens of this form before me, agreeing in characters and size; from this I opine they are more or less mature individuals. At any rate they certainly appear distinct from the earlier condition of any of the other species, so far as I know those portions of the latter. The species is remarkable for its narrow and almost flat venter, the lateral flatness of the whorls,

and hence generally compressed form ; the longitudinal narrow, and oval section is not seen in any other of our species.

The costæ are also more truly sigmoidal than in other Australian forms. The tubercles are arranged to some extent as in *C. plectoides*, with intervals occupied by non-tuberculated costæ, and like those of the latter they are always small. On the other hand, there is a most important difference between the initial whorl of the two species, here it forms a free open coil, but in *C. plectoides* the coil is close and the whorl contiguous ; I regard this initial condition as a very important feature in these shells. The almost flat flanks recall those of *C. leptus*.

The general appearance is very Ammonite-like, hence the specific name.

Loc.—Barcoo, Ward and Nive Rivers District, South-Central Queensland [A.M. (*H. W. Blomfield*)]. Port Douglas [G.S.Q].[34a]

Crioceras plectoides,[35] *sp. nov.*

(Plate xxxiii., fig. 2; Pl. xlvi., fig. 1; Pl. xlvii., figs. 1-4.)

Sp. Chars.—Shell of medium size, robust. Whorls contiguous, at least six, overhanging one another, and rapidly broadening as the shell grew ; initial whorl vermiform, with an acute apex ; venter obtusely rounded, broadening much with age ; abdominal margins rounded, indicated only by the positions of the distant tubercles ; dorsum flat, costate ; impressed zone wide and faintly indicated ; flanks obtusely rounded ; umbilical cavity wide, open and deep, the latter feature arising from the rounded and overhanging condition of the whorls ; section markedly quadrate. Sculpture similar throughout life, consisting of narrow, rounded costæ, seldom bifurcate, and varying in strength and distance apart according to position on the whorls ; simply transverse or very faintly concave backwards on the venter, convex forwards on the dorsum, and faintly sigmoidal on the flanks. Tubercles obtuse, node-like, in one row on each side the median line of the venter, and defining the abdominal margins not otherwise indicated ; at irregular distances apart, but closer in the young condition than during middle life and on single costæ ; in the

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[34a]If Port Douglas, north of Cairns, is meant, possibly a mistake has been committed in this locality. On Dunstan's Geological Sketch Map of Queensland (1905) the area around Port Douglas is coloured Desert Sandstone (Upper Cretaceous) ; the specimen has all the appearance of a Rolling Downs (Lower Cretaceous) fossil.

[35]πλεκτη a coil.

former stage there occur from three to five plain costæ between every two node-bearing ribs, but in the latter there may be as many as ten plain costæ occupying such a position, and here the tubercles often extend across three costæ, but without rendering the latter fasciculate. Septa concave on the whole, but with a very rolling surface arising from the development of the lobes and saddles, which are highly digitate.

Obs.—C. plectoides is remarkable for the general uniformity of its characters throughout the various stages of growth so far as they are known to me; it is a compact and well grown shell and one of the neatest of our *Crioceri*.

The costæ are narrow rounded ribs, not sharp crests, and appear to retain this character throughout life. Tuberculation of the costæ is similarly preserved, so far as the growth of the species is known to me. The tubercles are node-like, obtuse, and round in the earlier stages of growth, one to each costa, but in later conditions three ribs appear to be involved in each tubercle, the latter perched on them as it were; these, however, do not divert the course of the costæ and render them fasciculate. The finer details of the sculpture are unknown, as the test is not preserved in any case.

In the sectional outline of the whorls, and wide venter, *C. plectoides* approaches *C. nautiloides*, but differs in its costation and tuberculation.

The shaft and crozier are unknown.

Locs.—Cameron Downs, south of Hughenden, North Queensland [G.S.Q.]. Wellshot Run, near Barcaldine, Central Queensland [G.S.Q.]. Walsh River, a tributary of the Mitchell River, Cape York Peninsula [Q.M.]. Mount Cornish, near Muttaburra, Central Queensland [Q.M.]. Barcoo, Ward and Nive Rivers District [A.M. (*H. W. Blomfield*)]. Queensland? [U.S.]. ?Central Australia [G.S.].

Crioceras flindersi, *McCoy, sp.*

(Plate xxxvi., fig. 2; Pl. xxxix.; Pl. xl.; Pl. xli.; Pl. xlii., fig. 2; Pl, xliii.; Pl. xliv., fig. 2.)

Ancyloceras Flindersi, McCoy, Ann. Mag. Nat. Hist., 4., xx., 1867, p. 356.

Ancyloceras Flindersi, Eth. fil., Mem. Geol. Survey N.S. Wales, Pal. No. 11, 1902, p. 44, pl. viii., figs. 1-3.

Crioceras Flindersi, Eth. fil., S. Austr. Parl. Papers, 1905, No. 71, p. 14, pl. i., f. 1., pl. iii., figs. 1-8.

Sp. Chars.—Shell attaining a large size, robust. Whorls, at least four, close coiled, rapidly enlarging and overhanging one another; crozier sharply and shortly curved; shaft often with a compressed and lank or lean appearance; initial whorl vermiform, with an acute apex; venter of the whorls narrow and much arched in the young state, broadening and less arched in the older condition, narrow and gently rounded on the crozier and low convex or almost truncate on the shaft; abdominal margins rounded; dorsum flattened, costate, impressed zone very faintly indicated, more apparent in the young state, not visible on the shaft and crozier; flanks of the whorls and shaft compressed, flattened, on the crozier slightly rounded; umbilical cavity wide and open; section longitudinally oval. The nature of the costæ and tubercles varies according to growth and position; in the young state the costæ are obtuse and rounded, some more prominent and obtuse than others, single, or bifurcate low down on the flanks; as growth progressed the costæ became sharp and angular, and either single (venter, dorsum, and flanks), larger and smaller alternately, bifurcate as before, or fasciculate (flanks and venter) in bundles of two to four (usually three) on whorls, shaft, and crozier; on the venter straight, on the flanks sigmoidal, varying only in degree, and bent forwards on the dorsum; intercostal spaces, or valleys, very narrow in the young condition, wide and concave on the old whorls. Tubercles very prominent and well marked, one row on each side the middle line of the venter along the abdominal angles, and at irregular distances apart in the young, but on the maturer whorls, shaft, and crozier on nearly every costa or group of costæ; those of the simple costæ node-like, those uniting fasciculi on the whorls cristiform, elongated in the direction of the coil, those on the shaft low and conical; mid-lateral and dorso-lateral nodes absent.

Obs.—This is one of the three Australian *Crioceras* in which I have been able to trace the various parts of the entire shell, whorls, shaft, and crozier; the nature of the sculpture is so characteristic, little or no mistake can be made, the retention of strong fasciculate bundles of costæ and prominent nodes throughout life being very characteristic.

No doubt this shell attained to a very large size, although I have not the means of saying how large, but McCoy compared it with the *C. gigas*, J. de C. Sby., of the British Cretaceous, and speaks of it as a "gigantic" species. The largest portion of a whorl to come under my notice, as elsewhere recorded, is eight inches long by four and a half wide (*i.e.*, transversely), but this is only a portion of a flank, or side of a whorl the circumference

therefore, allowing for the full venter, dorsum, etc., must have been considerable.

The limb, or shaft, always has a laterally compressed or flattened outline, giving it a "lean" appearance, except in an instance to be noted immediately. The relation of limbs of this nature to the coiled portions is satisfactorily shown in a specimen from the Queensland Museum (Pl. xl., figs. 1, 2).

The costæ are more or less always sigmoidal on the flanks, often strongly so, frequently bifurcate, the points of bifurcation being either low down on the flanks, supra-dorsal to all intents and purposes, or along the middle line. The former occur on the flanks of the whorls usually, and the latter on the shaft; at these points the costæ are not tuberculate. These subdivided costæ may, or may not, pass over the venter singly; when not so doing they are gathered into fasciculate bundles along the rounded abdominal margins by the prominent tubercles. A fasciculus of three or four costæ on a flank may be continued across the venter as two costæ only, and *per contra*, a similar bundle on the latter may be represented on a flank simply by two also. A specimen in the National Museum, Melbourne, displays a marked departure from the typical condition of the costæ, in that many of the flank ribs are single, but on the venter between the two rows of tubercles all are double. The appearance of the tubercles is also worthy of note, in that they are cristiform, or longitudinally elongated on the whorls, other than the youngest, becoming more mammillary on the shaft and crozier.

I received from the Geological Survey of Queensland a portion of a large whorl measuring thirteen inches long by four inches in diameter, but in a poor state of preservation. In comparison to its size, the venter is not wide, but decidedly convex, although the flanks are by no means so. The dorsum is costate, without an impressed zone, and rather flat. The costæ are very large, one inch apart from crest to crest, straight and simple on the flanks, curved forwards on the dorsum, and directly transverse on the venter and double, the single line of nodes on each side separating these double costæ from the single on the flanks. This may be a condition of *C. flindersi*, like the smaller example already referred to as in the National Museum, Melbourne, one in which the fasciculate condition of the costæ on the flanks has not been developed; this opinion, however, is expressed with all reserve.

I now wish to draw attention to three marked conditions of costation, indicating its variability notwithstanding a fundamental resemblance throughout the whole suit of specimens.

Flinders River, Queensland.—Portion of a whorl, the flank costæ either single or in fasciculi of two, chiefly the latter, each fasciculus and single costa tuberculate along the abdominal lines. The venter is low convex, and in crossing it the single costæ become duplicated as well as those forming the fasciculi (Pl. xxxix., figs. 2 and 3).

Saltern Creek, Queensland.—Portion of a whorl, the venter low convex, the flank costæ again slightly sigmoidal in fasciculi of three to five. These fasciculi are complex, thus :—the nodes along the abdominal lines unite two or three costæ as the case may be, each group with an anterior and posterior rib derived from the others by bifurcation, the latter passing over the venter free without reference to the tubercles. On the other hand, those united by the tubercles either retain their individuality of two or three, or become four to the bundle (Pl. xl., figs. 3 and 4).

Wellshot (?), *Queensland.*—Portion of a large shaft or limb without the compressed or "lean" appearance already referred to, tentatively referred to *C. flindersi*. The venter is decidedly convex, the flank costæ faintly sigmoidal, and less oblique than in the two preceding instances. The abdominal tubercles either unite fasciculi of two flank costæ, or a tubercle of equal size interrupts the course of a single rib, but in either case all the costæ on crossing the venter are double. Here and there single costæ of equal strength to the former are interpolated between the fasciculi without relation to the latter, and are non-tuberculate; these encircle the whole limb. Another modification occurs by the anterior costa of one fasciculus, and the posterior of the fasciculus preceding being derived by bifurcation from one and the same parent rib along the mid-lateral or dorso-lateral lines. This is the most varied decoration of any of the specimens referred to *C. flindersi*, and, as already stated, the specimen is only provisionally placed with that species (Pl. xxxvi., fig. 2; Pl. xlii , fig. 2; Pl. xliv., fig. 2).

C. flindersi, by the characters of its costæ and tubercles, much resembles the European *C. seeleyi*, N. & U.[36]

In the specific description reference is made to the low convex or almost truncate condition of the shaft venter. This feature is reproduced in even a more marked degree on the shaft venter of *C. cordycepoides*, mihi,[37] and were it not for the second line of tubercles, dorso-lateral in position on the latter, and the difference in size, it would be difficult to separate *C. cordycepoides* from *C. flindersi*.

[36] Neumayr and Uhlig—Palaeontographia, xxvii., 1881, p. 185, pl. li., f. 1.
[37] Etheridge—S. Austr. Parl. Papers, 1905, No. 71, p. 14.

Another very interesting point in connection with this species is the occurrence in the Port Darwin beds of shaft portions[3 8] reproducing in every particular, in miniature, the features of the flat-ventered variety of *C. flindersi* just referred to. I am at present at a loss to account for these miniature forms at Point Charles, unless they represent a dwarfed race of species found in other portions of the Australian Cretaceous.

Loc.—Whitewood Ridge, Sesbania, North-Central Queensland [G.S.Q.]. Cameron Downs, south of Hughenden, North Queensland [G.S.Q.]. Flinders River, Carpentaria [Q.M.] Saltern Creek, north of Barcaldine, Central Queensland [Q.M.]. Wellshot Run, near Barcaldine, Central Queensland [G.S.Q.] Mount Cornish, near Muttaburra, Central Queensland [Q.M.]. Barcoo, Ward and Nive Rivers District [A.M. (*H. W. Blomfield*)]. Head of Flinders River, North Queensland [N.M.M. (*Messrs. Carson and Sutherland*; McCoy's type)]. Olive Downs, near Milparinka, North-west New South Wales [M.G.M.] Charlotte Waters, Central Australia [N.M.M., G.S.S.A.]. Dalhousie Springs, north of Oodnadatta, Central Australia [G.S.S.A.]. Central Australia [G.S.].

Crioceras lampros,[3 8a] *sp. nov.*

(Plate xlviii.)

Sp. Chars.—Shell ponderous, attaining a diameter of twenty-one inches at least, but only one and a quarter whorls are known. Venter generally truncate; abdominal lines indicated by a row of tubercles on each side the middle line of the venter; dorsum flat, costate, very broad at the distil end; impressed zone obliterated; flanks flattened, broad; section generally quadrate, becoming distinctly octagonal on the fully tuberculated costæ. Sculpture consisting of costæ of two kinds, primary and secondary; the former on the venter and flanks are large upstanding crests at regular intervals apart, and tubercle-bearing, but on the dorsum are not to be distinguished from the secondary costæ occupying the intercostal spaces; on the venter the costæ are straight (transverse), straight or very slightly curved on the flanks, and on the dorsum convex forwards. Tubercles very large and strong, in three rows on each side, one abdominal, one infra-abdominal, and the third supra-umbilical (or supra-dorsal).

Obs.—This form is known to me only as two almost completely exfoliated whorls of large size, and a few disjointed pieces. It

[3 8]Etheridge—*Ibid*, 1907 (Suppl. No. 55, 1906), p. 16, pl. x., figs. 6-9.

[3 8a]λαμπρὸς, magnificent.

vies in size with the large *Crioceras* in the Australian Museum already referred to, but the entire absence of any trace of tuberculation on the latter renders a further comparison impossible. It is the only instance amongst our large *Crioceri* of a shell bearing three rows of tubercles in advanced age; certainly *C. jackii* possesses the same number, but this occurs at the commencement of its career only.

The tubercles are borne upon what may be termed the primary costæ, which at the distal end of the coil are two and a half inches apart from crest to crest. On the dorsum, where some trace of the test remains, they decrease very greatly in size, and are there similar to the ordinary or secondary costæ. The section of the whorls when taken on the primary costæ is octagonal, viz., three angular lateral lines on each side or flank, with the truncate venter and flat dorsum, but if the section is taken on the secondary costæ in the valleys it is simply quadrangular; the infra-abdominal line of tubercles is the largest.

C. lampros must have attained a very large size; the diameter of the one whorl alone is twenty-one inches.

This is the only one amongst our *Crioceri* that conforms to Hyatt's definition of his Family Ancyloceratidæ, after the type of *A. matheronianum*, D'Orb.

A similar arrangement of the tubercles occurs in *C. thiollierei*, Astier,[39] and also in the smaller form *C. tabarelli*, Astier.[40]

Another exotic *Crioceras* much resembling this species in the form of the costæ and again in the presence of three rows of prominent tubercles is *C. munieri*, Sar. & Schön.,[41] of the French Neocomian.

In the Point Charles deposit, Port Darwin, occur fragments of whorls with three rows of tubercles. In this and *C. lampros* the tubercles are confined to the larger or primary costæ, and the venters are more or less flattened or depressed. In one case the tuberculate costæ are single,[41a] in the other they are double across the venter, between the latter and the flank nodes, and again between the latter and those along the dorsal edge, the nodes

[39] Astier—Ann. Sci. Phys. Nat. Soc. Nat. Agric. Lyon, (2), iii., p. 448, pl. xix., f. 7.

[40] Astier—*Loc. cit.*, p. 449, pl. xxi., f. 9.

[41] Sarasin and Schöndelmayer—Mém. Soc. Pal. Suisse, xxix., 1902, pl. xiv., f. 1.

[41a] Etheridge—S. Austr. Parl. Papers, 1907 (Suppl. to No. 55), 1906, p. 16, pl. x., figs. 4 and 5.

acting as centres of union.[41b] What the relation of these fragmentary and comparatively diminutive north-western forms may be to the larger species of Eastern Australia it is at present impossible to say.

Locs.—Cambridge Downs, near Richmond, North-Central Queensland [Q.M.]. (?)Maranoa River, South-East Queensland [G.S.—sketch].

The fine specimen (Pl. xlviii.) from the Queensland Geological Survey Collection is without a locality.

Crioceras cordycepoides, *Eth. fil.*

Ancyloceras cordycepoides, Eth. fil., S. Austr. Parl. Papers, 1905, No. 71, p. 14, pl. i., figs. 3-5; pl. ii., fig. 4.

Sp. Char.—Shell small, coil and shaft in one plane; proximal end of one whorl, little more than crooked, terminating in an obtuse apex; shaft slightly bent; venter truncate, flat; dorsum rounded; flanks slightly rounded; section longitudinally oval, or obscurely quadrate. Costæ strong, oblique on the flanks, straight or advancing ventrally and retreating dorsally, gathered into fasciculi of three or four costæ by a line of nodes along the dorso-lateral lines, and another along the abdominal lines, the median rib of each fasciculus stronger than the others; on the truncate venter usually straight, a few arched forward, corresponding in number to those of the flanks, and the median rib stronger than the others. Tubercules of the abdominal lines large and node-like, or produced as short acute spines.

Obs.—The resemblance of the shaft of this species to certain conditions of the corresponding part to *C. flindersi* has already been referred to.

Relying on Pictet and Loriol's illustration of *C.* (*Ancyloceras*) *tabarelli*, Astier,[42] I instituted a comparison between the latter and *C. cordycepoides*, but now I am in possession of Astier's Memoir, "Catalogue Descriptif des Ancyloceras," I find the resemblance to Astier's species[43] is not so close. There is this manifest difference—*C. tabarelli* possesses three lines of tubercles on each side the middle line of the venter, whilst *C. cordycepoides*,

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[41b]Etheridge—*Loc. cit.*, p. 16, pl. ix., figs 2 and 3.

[42]Pictet and Loriol—Descrip. Foss. Terr. Néoc. Voirons, Pt. 2, 1858, p. 27, pl. v., figs. 1-7.

[43]Astier—Ann. Sci. Phys. Nat. Soc. Nat. Agric. Lyon, (2), iii., 1851, pl. xxi., f. 9.

as already stated, has but two. *C. tabarelli* was selected by Hyatt as the type of his genus *Acrioceras.*[44]

C. cordycepoides and the next species, *C. laqueus*, are the only forms falling into Hyatt's Family Crioceratidæ, as defined by him.[45]

Loc.—Oaka-towya or Dalhousie Springs, north of Oodnadatta, Central Australia.

Crioceras laqueus, *Eth. fil.*

(Plate xlix., figs. 7-9.)

Ancyloceras or *Hamites*, sp., Eth. fil., Trans. Roy. Soc. N. S. Wales, xvii., 1883, p. 89, 2d pl., lower l. h. fig.

Hamites (?) *laqueus*, Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 496, pl. xlii., figs. 14 and 15.

Crioceras, sp., Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 502, pl. xxxiii., figs. 4 (? 5 and 6).

Anisoceras (?) sp., Eth. fil., S. Austr. Parl. Papers, 1905, No. 71, p. 14, pl. i., f. 2; pl. ii., figs. 1-3.

Sp. Chars.—Shell small. Whorls apparently not more than two; shaft long, curved; crozier comparatively large, unsymmetrical, loop- or link-shaped, returning directly towards the shaft, but not quite in the same plane, almost touching the latter; initial apex vermiform, blunt; lumen large. Venter of the whorls and shaft narrow but convex, comparatively broad on the crozier; dorsum of the shaft appears to be costate, but in the bend of the crozier flat and smooth; flanks gently convex. Costæ strong and sharp, transverse on the venter, oblique or slightly sigmoidal on the flanks, absent (?) on the dorsum of the crozier, some single, but usually fasciculate in bundles of two or three, the component ribs of each fasciculus united by a series of very prominent tubercles, supra-dorsal in position, again passing over the dorsum of the shaft single, double, or treble; along the abdominal lines on each side the middle line of the venter is a row of smaller tubercles or nodes, one to each costa.

Obs.—A comparison of all the specimens represented by the above synonomy has convinced me they are one and the same species, and that the name *Anisoceras* applied to one of them must be dropped.

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[44] Hyatt—Zittel's Text-Book Pal., Eastman's Edition, i., 1900, p. 588.
[45] Hyatt—*Loc. cit.*, p. 588.

In the specimens figured in the "Transactions of the Royal Society of New South Wales," and again refigured in the "Geology and Palæontology of Queensland," there is an indication of an oval margin or lip, in that the terminal costæ are much more prominent, and on the centre of the venter are backwardly curved, forming a kind of shallow "hyponomic" sinus.

The tuberculation of this form is very marked. There is a line of prominent, almost spine-like tubercles, supra-dorsal in position, which unite the costæ, or most of them, into bundles of two or three, but instead of then passing over the dorsum as single ribs, as is usually the case, the costæ again split up into a like number as before. Along each side the median line of the venter there is a further row of small pimple-like nodes, one to each costa.

There is another specimen that may be only a variety of *C. laqueus* (or possibly a distinct species) in which the venter is much broader, the costæ far more numerous and finer, but with the same marked supra-dorsal tubercles as in *C. laqueus* proper, although the rows of pimple-like nodes along the abdominal angles are absent. Again, at one end of the specimen there certainly seems to be a definite margin representing the lip of the living chamber with a shallow sinus, but in this instance the marginal costæ are not elevated above the others.

This form is represented in the Point Charles beds of the Northern Territory of South Australia by two indifferently preserved specimens. For the present I regard these fossils merely as a variety of *C. laqueus*.

In the "Geology and Palæontology of Queensland," etc., another specimen was figured,[46] apparently a portion of a shaft, and evidently related to *C. laqueus* in that some of the costæ are gathered in fasciculi by tubercles more nearly lateral than supra-dorsal, but as in the above species again dividing to pass over the dorsum. The identity of this specimen must for the present remain in doubt.

Loc.—Aramac Well (at 184 ft.), Aramac, Thomson River, Central Queensland [G.S.Q.]. Fifteen miles south-west of Hughenden, North-Central Queensland [G.S.Q.]. Tower Hill, Landsborough Creek, a head tributary of the Thomson River, North Queensland [Q.M.]. Barcoo, Ward and Nive Rivers District, South Queensland [A.M. (*H. W. Blomfield*)]. Dalhousie Springs, north of Oodnadatta, Central Australia [G.S.S.A. and A.M.]. (?)Point Charles Lighthouse, Port Darwin [A.M.(*Messrs. Christy* and *Godfrey*)].

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[46]Etheridge—Geol. Pal. Q'land., &c., 1892, Pl. xxxiii., figs. 5, 6.

Crioceras taylori, *Eth. fil.*

(Plate xlix., figs. 3-6.)

Ancyloceras Taylori, Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 498, pl. xlii., f. 13.

(?) *Ancyloceras, sp. ind.*, Eth. fil., Bull. Geol. Survey, Q'land, No. 13, 1901, p. 33, pl. ii., f. 5.

Sp. Chars.—Shell below medium size. Whorls apparently not more than three, close coiled; shaft moderately stout, slightly curved, but total length unknown; crozier loop- or link-shaped, unsymmetrically curved, returning directly towards the limb, but not quite in the same plane, almost touching the latter; venter of both whorls, shaft and crozier broad and rounded; dorsum of the whorls and shaft rounded, of the crozier flat; flanks of the whorls rounded, but of the shaft and crozier flattened; section of the shaft gradually becoming longitudinally oval, and on the crozier transverse or broad-oval. Costæ obtuse, on the whorls simple transverse and touching one another; on the shaft similar but separated by well marked valleys, those of the venter inclined forwards, on the dorsum backwards, and on the flanks slightly sigmoidal; on the crozier transverse or slightly sigmoidal, well separated, and often bifurcate, the bifurcation taking place low down on the flanks around the dorsal or umbilical edges. Tubercles absent.

Obs.—One of the most striking features of *C. taylori* is the general simplicity of its thick costæ. There is no trace of tubercles at any stage of growth.

C. taylori is undoubtedly allied to *C. laqueus* in size, form, and presence of the loop-like crozier, the remarkable fact being that the outer limb of the crozier is not quite in the same plane as the curve of the shaft proper, and whilst returning towards the latter does not appear to abut against it.

The costæ are round and cord-like, very regular, without fasciculation, and no trace of bifurcation until the curve of the crozier is reached In their simplicity they greatly resemble both those of the genus *Macroscaphites*, and *Ancyloceras simplex*, D'Orb., chosen by Hyatt as the type of his *Dirrymoceras*.[47]

I have provisionally incorporated in the synonomy the reference to an "*Ancyloceras*" I described from the collection of Mr. G. Sweet, Melbourne, obtained at Hughenden; it certainly possesses features in common with *C. taylori*.

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[47] Hyatt—Zittel's Text-Book Pal., Eastman's Edition, i., 1900, p. 586.

Portions of small *Crioceri*(?)[48] with simple, non-tuberculate costæ occur plentifully in the Port Charles and Shoal Bay beds of the Northern Territory, but the costæ are relatively coarser for the size of the specimens than those of *C. taylori*.

Locs.—Aramac Well, Aramac, Thomson River, Central Queensland [G.S.Q.]. Head of Walsh River, a tributary of the Mitchell River, Cape York, Queensland [Q.M.] Barcoo, Ward and Nive Rivers District [A.M. (*H. W. Blomfield*)]. (?)Central Australia [G.S.].

Crioceras (?), *sp.*

(Plate xxxv., fig. 2; Pl. xlii., fig. 1; Pl. xlvi., fig. 2; Pl. xlvii. fig. 5.)

Sp. Chars.—Shaft and crozier large, the extension of the former into the latter forming a broad curve, uncompressed. Shaft straight; venter narrow; abdominal lines defined by tubercles; dorsum broad and almost flat; impressed zone obliterated; flanks biangular, but on the whole rounded; section around the primary costæ unsymmetrically hexagonal, around the valleys broad-oval, or almost round. Costæ primary and secondary, the former single, strong, and often separated by shallow valleys of varying width, but usually wide; primary costæ of the shaft and crozier venters straight and trenchant between the two rows of tubercles marking the abdominal lines; on the shaft dorsum inclined slightly forwards; on shaft flanks oblique or faintly sigmoidal, and biangular, the angles separated by a line of dorso-lateral tubercles on each flank; costæ in the crozier bend straight; secondary costæ straight and flat, filling the valleys; test with delicate encircling lines. Tubercles arranged in two rows on each side the median line of the venter on the primary costæ only, two rows abdominal and two rows dorso-lateral, all conical, acute and prominent.

Obs.—I have here united three specimens, believing them to be the same, although differing in a few minor details; the coiled portions are at present unknown to me.

The first of the three specimens is a large shaft with very prominent, outstanding, and irregularly distant primary costæ; it is on the dorsum of this example that the secondary costæ and test are visible. It is a remarkable specimen, and in some of its aspects resembles the coil *C. lampros*, such as the angularity of the primary costæ, here hexagonal instead of octagonal as in the species named; the straight or horizontal nature of the trenchant primary costæ on the venter is another point of resemblance.

[48]Etheridge—Mem. Roy. Soc. S. Austr., ii., 1, 1902, p. 46, pl. vii., figs. 12, 13; S. Austr. Parl. Papers, 1907 (Suppl. to No. 55, 1906), p. 16, pl. ix., figs. 11-15.

The arrangement of the tubercles in three rows on each side the median line of the venter, and but two here, would in the ordinary course separate the two portions, but in many *Crioceri* the number of rows varies on different portions of the shells. There is, on this account, the bare possibility of the shaft now under description being that of *C. lampros*. Of the three specimens this also exhibits the truncate outline of the venter in a more marked degree than in the other two, although it is quite apparent there also.

Again, the hexagonal section around the primary costæ, the simplicity of the latter, and their markedly straight course and trenchant nature of the venter, with the additional line of tubercles on each side, will serve to distinguish this limb and crozier from those of *C. flindersi*, McCoy.

The second is a crozier and part of a shaft on which the primary costæ are more regularly spaced apart.

In the third specimen, provisionally united with the first and second, the proximal end of the limb is preserved (Pl. xlvi., fig.2); this does not lead to a coil, but is returned on itself in the form of a hook after the manner of D'Orbigny's *Hamites*. The contiguity of the two portions is so close there could by no possible means have been room for a coil; the deduction is therefore reasonable that we are here dealing with a specimen possessing generally the appearance of such a shell as *Hamites elegans*, D'Orb., nor does there appear to have been space for a second return of the limb as in *H. attenuatus*, J. Sby., the type of Hyatt's genus *Torneutoceras*.[19] On the whole, this form does not appear to be a *Crioceras* pure and simple, nor can it be included in the Hamitidæ of Hyatt's classification, one of the characters of the latter being "no tubercles at any stage."

Locs.—Tambo, Barcoo River, Central Queensland (Plate xlii., fig. 1) [A.M. (*Mrs. Alice Hamilton*)]. Barcoo, Ward and Nive Rivers District (Pl. xlvi, fig. 2; Pl. xlvii., fig. 5) [A.M. (*H. W. Blomfield*)]. (?)Central Australia [G.S.].

Genus Leptoceras, *Uhlig*, 1883.

(Denksch. K. Akad. Wissensch. Wien., xlvi., 2, 1883, p. 260.)

Obs.—Mr. V. Uhlig established *Leptoceras* as a subgenus of *Crioceras* for dwarfed forms with an open coil and the first or first and a half whorls noncostate, and the sutural divisions with few ramifications; he cited as examples of his subgenus *C. puzosianum*, D'Orb., and *C. cristatum*, D'Orb. The costæ are straight and slightly inclined towards the front. Uhlig remarks that the

[19] Hyatt—Zittel's Text-Book Pal., Eastman's Edition, i., 1900, p. 586.

difference between these dwarfed and little sculptured shells with comparatively simple sutures and the gigantic highly ornamented forms with abundantly ramified sutures is so marked that the bestowal of a subgeneric appellation seems perfectly just.

Messrs. Sarasin and Schöndelmayer,[50] on the contrary, consider Uhlig's *Leptoceras* to be based on fragments of much larger shells possessing a regular spiral, and terminal portions straight or curved.

We have in our Cretaceous one form that in all probability conforms to Uhlig's definition.

LEPTOCERAS (?) EDKINSI, *Eth. fil.*

Crioceras edkinsi, Eth. fil., Geol. Pal. Q'land, etc., 1892, p. 502, pl xxx., figs. 8, 9.

Sp. Chars.—Shell small, not exceeding three-quarters of an inch in diameter, open-coiled. Whorls not more than one and a half; shaft straight; venter narrow, convex; abdominal angles rounded, defined by small nodes; dorsum flattened and very feebly costate; impressed zone none; flanks very gently rounded, almost flat; section longitudinally oval. Costæ simple, obtusely angular, equidistant ribs, neither fasciculate, bifurcate, nor interpolate, but occasionally one becoming larger than the others; on the venter bent forwards, and steep-faced in that direction; on the dorsum faint but apparently bent forwards also; on the flanks oblique or here and there sigmoidal. Tubercles small, one row on each side the middle line of the venter, either on each costa or with intervening barren costæ.

Obs.—In 1892 I wrote as follows of this little shell:—"As the examples are numerous, and constant in their characters, they can only be regarded as adult individuals, and as such are certainly new to the Cretaceous rocks of Queensland;" this still holds good. It is a small and pretty species, and needs comparison only with some of the small forms from the Point Charles beds of Port Darwin.

Small more or less curved fragments[51] occur in the Point Charles beds with narrow rounded venters, and simple and equal costæ, with one row of nodes along each abdominal angle and on each alternate rib; there is a community of appearance between these and *L. edkinsi*.

Loc.—Wells (at 230 ft.) seven miles east of Mount Cornish Homestead, near Muttaburra, Central Queensland [G.S.Q.].

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[50] Sarasin and Schöndelmayer—Mém. Soc. Pal. Suisse, xxix., 1902, p. 97.

[51] Etheridge—Mem. Roy. Soc. S. Austr., ii., 1, 1902, p. 46, pl. vii., figs. 14, 15; S. Austr. Parl. Papers, 1907 (Suppl. to No. 55), 1906, p. 16.